Author: Matthew S. Johnson
NASA Ames Research Center, M/S 232-21, Moffett Field, CA 94035
E-mail: matthew.s.johnson@nasa.gov

Analyzing source apportioned methane in northern California during DISCOVER-AQ-CA using airborne measurements and model simulations

Abstract

This study analyzes source apportioned methane (CH_4) emissions and atmospheric concentrations in northern California during the Discover-AQ-CA field campaign using airborne measurement data and model simulations. Source apportioned CH_4 emissions from the Emissions Database for Global Atmospheric Research (EDGAR) version 4.2 were applied in the 3-D chemical transport model GEOS-Chem and analyzed using airborne measurements taken as part of the Alpha Jet Atmospheric eXperiment over the San Francisco Bay Area (SFBA) and northern San Joaquin Valley (SJV). During the time period of the Discover-AQ-CA field campaign EDGAR inventory CH_4 emissions were ~5.30 Gg day^{-1} (Gg = 1.0×10^9 grams) (equating to ~1.9×10^3 Gg yr^{-1}) for all of California. According to EDGAR, the SFBA and northern SJV region contributes ~30% of total emissions from California. Source apportionment analysis during this study shows that CH_4 concentrations over this area of northern California are largely influenced by global emissions from wetlands and local/global emissions from gas and oil production and distribution, waste treatment processes, and livestock management. Model simulations, using EDGAR emissions, suggest that the model under-estimates CH_4 concentrations in northern California (average normalized mean bias (NMB) = -5% and linear regression slope = 0.25). The largest negative biases in the model were calculated on days when "hot spots" of local emission sources were measured and atmospheric CH_4 concentrations reached values >3.0 parts per million (model NMB = -10%). Sensitivity emission studies conducted during this research suggest that local emissions of CH_4 from livestock management processes are likely the primary source of the negative model bias. These results indicate that a variety, and larger quantity, of measurement data needs to be obtained and additional research is necessary to better quantify source apportioned CH_4 emissions in California and further the understanding of the physical processes controlling them.